ST. ANDREWS PRESBYTERIAN COLLEGE • LAURINBURG, NORTH CAROLINA •

PALEY AND PROOF: THE ELUSIVE QUEST FOR CERTAINTY

OWEN GINGERICH, PH.D.
OCTOBER 26, 2006

THE JOHN CALVIN MCNAIR LECTURE
ON SCIENCE AND THEOLOGY

HISTORY OF THE JOHN CALVIN MCNAIR LECTURE ON SCIENCE AND THEOLOGY

John Calvin McNair was born in 1823, educated at the University of North Carolina in Chapel Hill (BA 1849; MA 1852) and received his Divinity Degree from Columbia Seminary in 1856. In preparation for travel to Scotland in 1857, McNair executed a Will leaving his estate in trust for the benefit of his mother during her life and then to the University of North Carolina to establish a series of lectures. "The object of the lectures shall be to show the mutual bearing of Science and Theology upon each other and to prove the Existence and Attributes, as far as may be, of God from Nature."

McNair died in 1858 while traveling and studying in Scotland. Twenty-five years later, his mother died and efforts were begun to transfer the remainder of his estate to the University. A family disagreement over the sale of land in the estate, however, delayed settlement until 1906 when the assets, valued at $14,200, were finally transferred to the University. Interest earned on the McNair Endowment Fund made it possible for the first lecture to be given in 1908 by Professor of Physics Francis H. Smith of the University of Virginia. Over the next nearly 100 years, the McNair Lecture on Science and Theology was delivered 52 times by some of the most pre-eminent scholars of the 20th century, not all of whom adhered to the original intent of the lecture as defined in McNair's will.

In 1995, several of McNair's descendants expressed concern to the University that the purpose of the McNair Lectures was being disregarded both in the choice of speakers and in the subject matter they were being asked to address. Over the next ten years, the descendants, represented by Robert J. Powell, a 1939 graduate of Presbyterian Junior College, made every effort to work with the University to focus the annual lecture on McNair's original intent, but ultimately to no avail.

In 2005, the University acknowledged that it was unable to comply in a consistent way with the terms of the will and agreed to transfer the McNair Endowment, now valued at approximately $300,000, to the Presbyterian Church (USA) Foundation to be held in trust and used as directed by the Board of Christian Education of the Presbyterian Church (USA). With the support of the McNair descendants and an enthusiastic commitment by the trustees of St. Andrews Presbyterian College, the Board of Christian Education directed that the income from the McNair Endowment be given to St. Andrews to be used at its discretion. In response to this remarkable gift, the College agreed to continue the McNair Lecture annually with the inaugural lecture on the St. Andrews campus given on October 26, 2006.

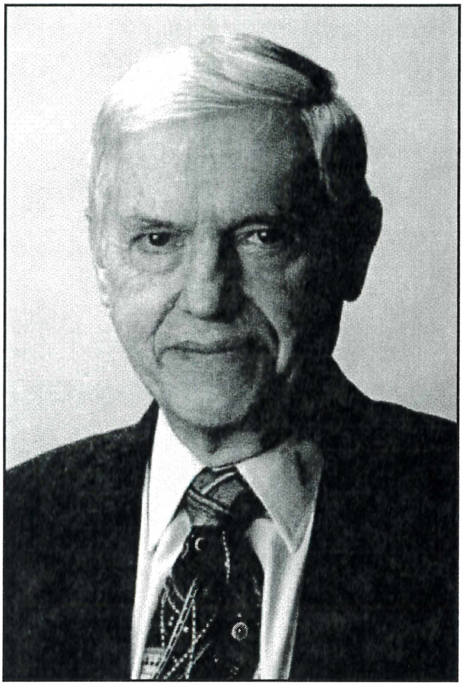
PALEY AND PROOF: THE ELUSIVE QUEST FOR CERTAINTY

OWEN GINGERICH, PH.D.
Professor Emeritus of Astronomy and History of Science
Harvard-Smithsonian Center for Astrophysics

THE 2006 JOHN CALVIN MCNAIR LECTURE
ON SCIENCE AND THEOLOGY
St. Andrews Presbyterian College
Laurinburg, North Carolina
October 26, 2006

OWEN GINGERICH, PH.D.

Professor Emeritus of Astronomy and History of Science
Harvard-Smithsonian Center for Astrophysics



Professor Gingerich's recent books include God's Universe and The Language of God. He says the universe and life on Earth make more sense if the divine will designed things in a purposeful way. But this can be neither denied nor proved by scientific means any more than science explains realities such as love and beauty.

Professor Gingerich's research interests have ranged from the recomputation of an ancient Babylonian mathematical table to the interpretation of stellar spectra. He is co-author of two successive standard models for the solar atmosphere, the first to take into account rocket and satellite observations of the sun; the second of these papers has received more than 500 literature citation.

In the past three decades, Professor Gingerich has become a leading authority on the 17th-century German astronomer Johannes Kepler and on Nicholas Copernicus, the 16th-century cosmologist who proposed the heliocentric system. The Harvard-Smithsonian astronomer undertook a three-decade-long personal survey of Copernicus' great book *De revolutionibus*, examining more than 580 16th-century copies in libraries scattered throughout Europe and North America, as well as those in China, Japan, and Australia. His annotated census of these books was published in 2002 as a 434-page monograph. In recognition of these studies he was awarded the Polish government's Order of Merit in 1981, and more recently an asteroid has been named in his honor. An account of his Copernican adventures, The Book Nobody Read published in 2004 by Walker & Co., has now been issued as a Penguin paperback. He has given the George Darwin Lecture (the most prestigious lecture of the Royal Astronomical Society).

PALEY AND PROOF: THE ELUSIVE QUEST FOR CERTAINTY

John Calvin McNair, a graduate from the University of North Carolina in the class of 1849, in his will established a lecture series with the intention "to show the mutual bearing of Science and Theology upon each other and to prove, as far as may be, the Existence and Attributes of God from Nature." When President Deegan reminded me of McNair's instructions, I was immediately struck by their similarity to a highly influential book that was still widely read when McNair was an undergraduate, the Reverend William Paley's *Natural theology: or, Evidences of the Existence and Attributes of the Deity.* He opens, famously, with the lines:

> In crossing a heath, suppose I pitched my foot against a stone, and were asked how the stone came to be there; I might possibly answer, that, for anything I knew to the contrary, it had lain there forever . . . . But suppose I had found a watch upon the ground, and it should be inquired how the watch happened to be in that place; I should hardly think of the answer which I had before given.

I need not quote further, for I'm sure you know the argument. There must be an artificer who designed its use, an invincible argument, Paley declares. To say otherwise is atheism, he says, (and again I quote) "for every indication of contrivance, every manifestation of design, which existed in the watch, exists in the works of nature; with the difference, on the side of nature, of being greater and more, and that in a degree which exceeds all computation." But Paley, in linking one of his favorite words, contrivance, with design, inevitably draws a picture of a mechanician or even a tinkerer sitting there putting the biological world together bit by bit.

Stirring as these passages are, I think they paint a somewhat problematic picture of God and God's role in the universe. Paley was creating the image that God, the white-haired old man of the Sistine Chapel ceiling, gets up from his throne and goes off to his workshop to tinker some more. This is a highly anthropomorphic God, built in our image.

Yet, should we follow McNair's directions to examine the attributes of God from nature, and reflect how incredibly vast and ancient the universe seems to be today than it was envisioned a century and a half ago, we would have to fall down before that awesome throne and say that this power and glory lies far beyond our imagining and comprehension. Walt Whitman writes that a mouse is enough to stagger sextillions of infidels,[1] and whether we look deep within atomic structures or out to the realm of galaxies and quasars, it is indeed staggering in its scale, its magnificence, its beauty. But there is something else deeply extraordinary: that the universe, complex and astonishing as it is, seems to be comprehensible. Why should that be? For science, that is an unanswerable question. For many materialistic scientists the universe is ultimately without meaning or purpose. As for me, I am psychologically incapable of considering that the universe is simply a macabre joke. I cannot claim to have the answers, to know what the purpose of the universe is, but I do believe that there is a significant clue in the most important verse of the first chapter of Genesis: "God created man in his own image, male and female created he them." We have within us some sparks of divine creativity, something in God's image that allows us to begin to understand the structure of the universe itself. As we seek to understand God, however imperfectly, we are doing so in the light of those divine creative sparks within us.

The *attributes* of God — this is what we are seeking through our theology, our philosophy, and our science. But Paley and McNair both ask us for evidence of the *existence* of the deity, for proofs, if you will, so I'm sorry to say that in the century of McNair lectures, the proofs have not been forthcoming. As one of the previous McNair lecturers, John Polkinghorne, said on another occasion, we don't find the answers by looking for items trademarked "Heavenly Construction Company."[2] This is surely a theological riddle. But perhaps something is to be gained by examining in historical perspective the role of proof in our modern scientific understanding of the physical and biological world around us, to see how this illumines the paradox that a convincing logical proof of God's existence has not been found. And so I would like to recount the some aspects of a very famous episode in the history of science and religion, the so-called Galileo affair.

This took place around the time of the King James Bible, or the Pilgrims landing at Plymouth, or even the founding of Harvard College. It was a time when most people took a very common sense view of the earth and sky. If the earth was twirling at a dizzying speed, once around every 24 hours, and if you threw a stone high into the air, it would surely land in another country. And think of the poor birds! Ridiculous! What a silly idea that man Nicolaus Copernicus had. Surely the moon would get lost if the earth were whizzing around the sun each year. Besides, doesn't Psalm 104 say that the Lord God laid the foundation of the earth that it not move forever?

This was the cultural and religious background when Galileo Galilei began teaching in Padua, Italy, near the end of the 16th century. Galileo taught the standard geocentric astronomy of the liberal arts curriculum, although he confessed in a private letter to Johannes Kepler that he was a secret Copernican. He did not come out of the closet, so to say, with his heliocentrist views until something novel happened. In 1609 he learned that peddlers elsewhere in Europe were offering a magic tube with lenses that made distant objects appear closer. Intrigued, he figured out how it was done, and he went to work making better lenses so that he was able to turn a carnival toy into a scientific instrument. By November of that year he discerned the craters on the moon's surface, and then, in January 1610, he discovered that the planet Jupiter was accompanied by four small moons. His observing log is one of the most fascinating manuscripts in the history of science. At first, puzzled by what he was seeing, his notes are in Italian, but by the end of the week, when the significance of his observations had gradually dawned on him, he switched to Latin, the *lingua franca* of the international science community. With six weeks he had rushed his news into print in his *Sidereus nuncius*.

And in this "Starry Messenger" he allowed himself a Copernican remark. "We have here a splendid argument for taking away the scruples of those who are so disturbed in the Copernican system by the attendance of the moon around the earth while both complete the annual orbit around the sun that they conclude this system must be overthrown as impossible. For our vision offers us four stars wandering around Jupiter while all together traverse a great circle around the sun."[3] I would suggest that this realization, that if Jupiter could keep its moons in tow, so could the earth, was absolutely central to Galileo's conversion to a strong, enthusiastic heliocentrism.

His book, dedicated to Grand Duke Cosimo dei Medici in

Florence, brought him a new job offer, and by August of 1610 Galileo had become an ornament to the Florentine court. Within a few months Galileo had a new telescopic discovery to report: The planet Venus showed phases like the moon, something quite understandable if Venus orbited around the sun. But according to Ptolemy, the ancient architect of the geocentric system, Venus cycled around in front of the sun, in which case Venus should exhibit quite a different pattern of phases than those Galileo saw. Here was a solid nail in the coffin of Ptolemaic astronomy.

Within a few months the authenticity of the Galileo's observations came up at court, or more precisely, at a party with the young Grand Duke's powerful mother, Christina. Galileo was not present, but his protege Benedetto Castelli was, and Christina asked him if the observations of the moons of Jupiter were real. Absolutely, Castelli declared; even the Jesuit astronomers at the Collegio Romano had verified them. Then Christina turned to the Copernican system, remarking that at the Battle Gibeon, Joshua had commanded the sun, not the earth, to stand still. Castelli countered that Galileo could surely show that the heliocentric arrangement was not contrary to Scripture. While Galileo's theological instincts were sound, he was not trained as a theologian, and for an outsider to venture an opinion on theological matters was to tread on dangerous ground. By saying very cleverly that 'the Bible teaches how to go to heaven, not how the heavens go," even though he was quoting the Vatican's cardinal librarian, he exposed himself to the ire of conservative churchmen. And when he actually wrote out a Copernican defense for the Grand Duchess Christina, the fat was in the fire. Eventually a copy ended up on the desk of Robert Cardinal Bellarmine, who was by then Rome's leading theologian.

In his reply, the cardinal said, "Since you have little time for reading and I for writing, I shall be brief. First, I say that it appears to me that you did prudently to content yourself with speaking hypothetically, as I have always supposed Copernicus did."[4] It is clear that Bellarmine, like many others before and since, was still unaware that the author of the anonymous introduction to *De revolutionibus*, which essentially said that the work was a recipe book for calculating the positions of planets and not a true physical description of the cosmos, was not Copernicus himself. This brief, unsigned warning to readers had been added by the proofreader, the Lutheran minister Andreas Osiander, who announced that “these hypotheses need not be true nor even probable.”

It is also clear that Bellarmine was unwilling to concede the motion of the earth in the absence of an irrefutable deductive proof, since he went on to state, "For to say that assuming the earth moves and the sun stands still saves all the appearances better than eccentrics and epicycles is to speak well. This has no danger in it, and suffices for the mathematicians. But to affirm that the sun is *really* fixed in the center of the heavens and that the earth revolves very swiftly around the sun is a dangerous thing, not only irritating the theologians and philosophers, but by injuring our holy faith and making the sacred scripture false."

Bellarmine re-emphasized why he thought that the Copernican system could only be hypothetical when he added, "If there were a true demonstration, then it would be necessary to be very careful in explaining Scriptures that seemed contrary, but I do not think there is any such demonstration, since none has been shown to me. To demonstrate that the appearances are saved by assuming that the sun is at the center is not the same thing as to demonstrate that in fact the sun is in the center and the earth in the heavens."

To understand Bellarmine's argument more clearly, let us briefly detour to note the two forms of logical reasoning already delineated by Aristotle in his *Posterior Analytics*. First of all there is *induction*, the art of generalizing that lies at the basis of much of our learning. Consider the following example, which begins with a series of observations:

Ducks reproduce by laying eggs.
Robins reproduce by laying eggs.
Wrens reproduce by laying eggs.
Pileated woodpeckers reproduce by laying eggs.
.... etc.

From a long sequence of observed examples, we can conclude that

Birds reproduce by laying eggs.

Is this indisputable truth? Not guaranteed, because we have not yet observed *all* the species of birds. For a route to irrefutable truth, we need to consider deduction:

MAJOR PREMISE
If it's raining, the streets are wet.
MINOR PREMISE
It is raining!
DEDUCTION OR CONSEQUENT
The streets are wet.

If the premises are true, the deduction must be logically true. However, there was a well-known logical trap with deduction, known as *affirming the consequent*:

MAJOR PREMISE

If it's raining, the streets are wet.

MINOR PREMISE

The streets are wet.

DEDUCTION OR CONSEQUENT

It is raining!

Is this a logically correct, foolproof deduction? Not at all. There are many other reasons why the streets could be wet. Winter snows could be melting, the street-cleaning crew could have been at work, the Budweiser horses may have been on parade! But is not the following another example of affirming the consequent?

MAJOR PREMISE

If the Copernican system is true, Venus should show phases.

MINOR PREMISE

Galileo has found the phases of Venus.

DEDUCTION OR CONSEQUENT

The earth must be moving around the sun.

Is this a foolproof argument for the earth's motion? No, because there might be another arrangement in which Venus goes around the sun, but the earth does not. In other words, even though the observed phases of Venus contradicted the traditional Ptolemaic placement of the planets, it did not guarantee the Copernican arrangement, because, as Bellarmine implied, even though a Copernican system would produce the observed pattern of full and crescent phases, this did not mean that some other arrangement might not equally well explain them.

In particular, the Danish astronomer Tycho Brahe had proposed a system in which Venus revolved about the sun, but at the same time the earth was at rest. In Tycho's system both the moon and sun revolved about the fixed earth, but the sun carried the other planets around with it, all of them orbiting the moving sun. Hence Bellarmine had no trouble accommodating the phases of Venus with a motionless earth. For Bellarmine, the earth was still the glorious fixed pivot of all creation.

Galileo was clever enough to see the point, yet deep down he must have felt that the Copernican system represented a real physical possibility in a way that the artificial and contrived Tychonic system did not. In the Copernican system the earth and moon were planetary bodies entirely different from the sun. The Tychonic system simply blurred this important insight. But there was something even more compelling. In the Copernican system the planets were automatically and necessarily arranged in order of their periods, with Mercury, the fastest planet, on the inside and Saturn, the slowest, at the outside. The earth, with a period of 365 days, fell naturally between Venus at 225 days and Mars at 687 days. The aesthetic appeal of this arrangement was jarringly disrupted in the Tychonic system. Tycho's jury-rigged system was simply ugly.

As long as the Copernican system remained a mathematical game, with astronomers using the circle as hypotheses, "not necessarily true nor even probable" as Osiander's introduction had put it, it represented no threat to the Catholic, or for that matter to the transAlpine Lutheran, position. With the Tychonic system as the clerics' new favorite, they had a fallback position, but one not entirely safe against the aesthetic appeal of the Copernican cosmology. Hence all Catholics needed to be reminded, forcefully, that the Copernican scheme was hypothetical and even taboo.

The Inquisition’s censors, the committee that ran the *Index of Prohibited Books*, did not want to ban Copernicus’ book outright because the observations it reported might prove invaluable for future calendar reform. However, they believed that some subtle changes of the text could make it appear as a computing system that had no claims to reality. One surprising place is where Copernicus exclaimed, “So vast, without any question, is the Divine Handiwork of the almighty Creator!”[5] Why excise such a pious statement? Simply because there was too much whiff of reality here, as if Copernicus was saying that this is the system the Creator used in framing the Universe. In not quite a dozen places the censors denatured the text.

Soon after Galileo's audience with Cardinal Bellarmine, rumors began to fly in Rome that not only had Copernicus’ book been censored, but that Galileo had been officially censured and was required to undergo salutary penance for having taught the Copernican doctrine. As a result, Galileo asked the Cardinal for a letter of clarification, and Bellarmine wrote to him that, "Having heard it calumniously reported that Signor Galilei has in our hand abjured and been punished, we do hereby declare that he has not abjured any opinion or doctrine held by him, nor has any salutary penance been imposed on him, but only he has been notified of the declaration made by the Holy Father and published by the Sacred Congregation of the Index wherein it is set forth that the doctrine attributed to Copernicus is contrary to Holy Scriptures and therefore cannot be defended or held."[6]

Galileo returned to Florence and for seven years maintained his silence on cosmology. The censorship seemed to be holding. But in 1623 circumstances changed in Rome: a liberal Florentine acquaintance of Galileo's was elected pontiff. Before a year had passed, Galileo had hastened to Rome for a series of interviews with the new Pope, Urban VIII. We do not know what passed between them, but whatever was said, Galileo left Rome with the impression that he was at last free to discuss the heliocentric cosmology. Back in Florence he began to write his *Dialogue Concerning the Two Chief World Systems*.

Galileo undoubtedly hoped to find a proper deductive proof for the motion of the earth, and there were probably some moments when he really believed that he had proved the earth's motion with his doctrine of the tides and with his observations of the movement of sunspots. At the same time, he knew intellectually, as Urban VIII must have pressed on him, that just because a moving earth could explain the tides, this did not necessarily mean that God hadn't created the tides in some other, quite different way. With all of his instincts urging him toward a Copernican viewpoint, Galileo was ultimately left without a satisfactory "proof positive" of the earth's motion.

What Galileo could do, and all too brilliantly, was to turn from the logic of proof to the rhetoric of persuasion. What Galileo had was a series of examples that made good sense with the heliocentric blueprint, the phases of Venus and the motions of sunspots being good examples. As a document of persuasion, Galileo's Dialogo succeeded magnificently. If Urban VIII had expected an informed discussion of the merits of Aristotelian/Ptolemaic system versus the Copernican system, he got his desires. However, if expected a dispassionate, neutral account, he had lost. He had reminded Galileo that God could have created the tides any way he pleased. What he surely did not expect was to have his cautious words placed in the mouth of the Aristotelian defender, Simplicio, named after a genuine sixth-century commentator but whose name is also a splendid pun on the word "simpleton." We do not know for sure why Urban VIII responded with such apparent enmity. Perhaps it was this perceived insult. In any event, Urban unleashed the forces of the Inquisition and ultimately Galileo was forced to read a humiliating abjuration and was placed under house arrest for the remainder of his life.

But let us pause to ask what it would have taken to convince Bellarmine or Urban VIII that the Copernican system was a correct, physically real description of our universe? For example, most astronomy textbooks today list the Foucault pendulum as the proof of the earth's rotation, and the annual stellar parallax as the proof of the earth's yearly revolution around the sun. Would these evidences have converted those theologians to the Copernican doctrine, and if not, why not? What would it have taken to persuade Bellarmine that the earth moved? Suppose that the Foucault pendulum had been set in motion with its shifting orientation of the swing. What would he have made of that? Well, why not suppose that the influences of the whirling stars caused the plane of oscillation of the pendulum to rotate? This is not a frivolous way out, for it is the general relativistic explanation. And what if the annual stellar parallax had been found? Well, why not let each star have its own tiny epicycle, cycling around each year? I believe such an explanation would have naturally occurred to Bellarmine. You may immediately think of Ockham's razor, that the simpler explanation would surely prevail. But remember that Ockham's razor is not a law of physics. It is an element of rhetoric, in the tool kit of persuasion. In the absence of new physics, a myriad epicycles might not have been an obstacle to keeping the earth safely fixed.

Why is it that we today find the so-called proofs of the earth's motion—the stellar parallax and the Foucault pendulum—so convincing when they could not have been guaranteed to convince Bellarmine or Urban? The answer is of course that the required new physics has arrived. We are post-Newtonian, and it is in the Newtonian framework that these fundamental experiments provide persuasive evidence. In fact, the Newtonian achievement was so comprehensive and coherent that the specific proofs were not needed. Thus there was no dancing in the streets after Foucault swung his famous pendulum at 2 a.m. on Wednesday morning, January 8, 1851, nor had there been grand celebrations in 1838 after Bessel had announced the successful measurement of an annual stellar parallax. The Copernican system no longer needed these demonstrations to win universal acceptance.

If "scientific proof positive" was at stake in the Galileo affair, then Urban VIII won the debate. But in reality Galileo won. From 1632 on, creative science was on the side of Copernicus. Those natural philosophers at the forefront of science, those who were pushing out the frontiers, became heliocentrists, despite the lack of proof of the earth's motion. Why? Because Galileo's observations of the phases of Venus showed that Ptolemy was wrong. Given the choice, the Copernican arrangement was aesthetically pleasing while the Tychonic arrangement was clumsy and a dead end. In the Copernican system the sun was indeed a royal governor, hinting at a possible heliocentric physics. Before the seventeenth century had run its course, Isaac Newton proposed a dazzling new celestial physics, in which a massive, gravitating sun deflected the planets into their curved paths. He had no *proof* of the earth's motion, but his awesomely comprehensive and coherent mathematical principles of natural philosophy made no sense without that assumption.

Science as we have come to use it relies very little on proof. Science is primarily looking for a self-consistent description of nature that hangs together in a convincing way—precisely the sort of story that Galileo displayed in his *Dialogo*. Science works by coherence, not by proof. By seeking convincing explanations that made sense of the new observations, Galileo had changed the rules of science and had thereby ultimately triumphed in the debate. Coherence, not proof, had won the day.

What, then, are the take-home lessons for the 21st century? There are, I believe, two important lessons. First, it seems that the motto Galileo repeated, that "the Bible teaches how to go to heaven, not how the heavens go," is still very relevant today. On questions of science and religion, and what should be taught in the biology classrooms, our country is deeply polarized. There are many folks who take in their stride the modern technology of cell phones, laser scanners, airplanes, and atomic bombs, but who are nevertheless reluctant to accept the implications of the science that lies behind these awesome inventions of the past century. In particular, many are very uneasy and ill equipped to understand the long time scale that astronomers accept in describing the origin of the universe or the five-billion-year age of the earth itself. When Darwin wrote his *Origin of the Species*, he devoted considerable attention to question of the earth's antiquity, and since his time a variety of independent methods lead with considerable accuracy to these large numbers. I suppose the hesitation to accept them comes from a very literal reading of the Biblical genealogies. It was Galileo who said that the Book of Scripture and the Book of Nature had the same author, and if they seem to disagree, one has to look carefully to see where some misinterpretation was at fault.

Darwin's theory of evolution is a crucial hinge point for many close readers of Genesis I who take the days of creation quite literally. Modern science confirms that our observable universe had a specific beginning, a moment of creation, if you will, and likewise the earth itself, somewhat later, had its own cosmic origin. The scientific account reveals a long, intricate process of the slow creation of the elements requisite for life, the gradual evolution of the earth's atmosphere to hold enough oxygen to serve as the energy resource for complex organisms, and an ancient but comparatively recent emergence of creatures with language, conscience, and self-consciousness. Does this mean that science has negated Genesis 1? Or rather, must we simply look elsewhere for a profound meaning of the opening chapter of Genesis? This is not a lecture on hermeneutics, that is, on Biblical interpretation, but since I have opened this door a crack, let me give you one hint.

Genesis 1 does not say that God created the sun and the moon. "Wait a minute," many of you are thinking, "I'm sure I remember that it says just that." But the text says God created a greater light and a lesser light, not the sun and the moon. Why the circumlocution? Because the words for sun and moon stood for gods in the Babylonian pantheon, and the Hebrews were having none of that. For the ancient Hebrews, the great Genesis paean to God's creativity was not so much a scientific statement as a political statement, saying to the Babylonian neighbors (and sometime overlords) that their world was made not by a squabbling group of contentious deities but by a single mighty Creator, an idea that has resonated down through the ages as a sense of unity of nature that underpins all of modern science.

Earlier I indicated that there is a second take-home message from the Galileo Affair, and it has to do with the profound way in which

Galileo moved science forward, by proposing not irrefutable proofs but coherent descriptions. There are today many scientists who still believe that science marches ahead by rigorous proofs, so when I argued this alternative viewpoint in one of the Galilean towns, Padua, a decade ago, I was a little nervous because one of the smartest persons I know, Nobel laureate Steven Weinberg, was in the audience. But when I finished, he was the first to jump up and proclaim "Amen! — science works by coherency, not by proofs!"

But just as I am willing to accept a science that weaves its beautiful tapestry by making a picture that hangs together, I am also willing to accept a religious stance that finds no proof of God's existence through the evidences of science – pace Paley and McNair. What is required is a fabric of understanding that makes sense. I cannot answer profound questions such as why there is something rather than nothing, or why is the universe comprehensible. But I come closer to the answers through my belief in a benevolent Creator, who reveals himself through human thought and exploration and thus in the words of sages and prophets of all ages. In the words of my admirable friend John Polkinghorne, in a statement he made in a debate with Steven Weinberg when he defended his belief in a designed universe, "I think I have good reasons for my beliefs, but I do not for a moment suppose that my atheistic friends are simply stupid not to see it my way. I do believe, however, that religious belief can explain more than unbelief can do."[7]

Let me quote a paragraph from my recent book, *God's Universe*: "To believe in a designed universe requires accepting intention and purpose. And if that purpose includes contemplative intelligent life that can admire the universe and can search out its secrets, then the cosmos must have those properties congenial to life. For me, part of the coherency of the universe is that it is purposeful—though probably it takes the eyes of faith to accept that. But given that understanding, then the principle that states that our universe must be congenial to life also becomes the evidence of design,"[8] or in Paley's sense, evidence of the existence of the deity. This is, however, not a logical proof, but persuasion.

It is persuasion that I subscribe to, and if that means living with uncertainty, so be it. To me, that seems to be the very nature of the astonishing universe in which we find ourselves. So let me end the same quotation from Pascal with which I closed my book:

The heart has its reasons that reason does not know.

1. Walt Whitman, “Song of Myself” in *Leaves of Grass* (Boston, 1891–92), stanza 31.
2. John Polkinghorne, “Understanding the Cosmos,” in *Cosmic Questions (Annals of the New York Academy of Sciences*, 950 [2001]): 175–182, esp. 175.
3. Galileo Galilei, *The Starry Messenger*, translated in Stillman Drake, *Discoveries and Opinions of Galileo* (Garden City: Doubleday, 1957), p. 57.
4. Bellarmine to Foscarini, 12 April 1615, *Le Opere di Galileo Galilei*, xii, 171-72; abridged from the translation in Stillman Drake, *Discoveries and Opinions of Galileo* (Garden City, 1957), pp. 162-64.
5. Nicolaus Copernicus, *De revolutionibus Orbium Coelestium*, (Nuremberg, 1543), end of Book 1, Chapter 10.
6. Bellarmine to Galileo, 26 May 1616, *Le Opere di Galileo Galilei*, xix, 348; abridged and revised from the translation in Giorgio de Santillana, *The Crime of Galileo* (Chicago: University of Chicago Press, 1955), p. 132.
7. John Polkinghorne, “Understanding the Cosmos,” *Cosmic Questions (Annals of the New York Academy of Sciences,* 950 (2001)): 175–182, esp. pp. 177–178.
8. Owen Gingerich, *God’s Universe* (Cambridge: Harvard University Press, 2006), p. 77.

THE JOHN CALVIN MCNAIR LECTURE
ON SCIENCE AND THEOLOGY

St. Andrews Presbyterian College
1700 Dogwood Mile
Laurinburg, N.C. 28352
churchrelations@sapc.edu